



# Cummins Westport Inc.

## Natural Gas Engine Business



**Westport**



# Cummins B5.9G & B5.9LPG



Spark ignited dedicated  
LPG & Natural Gas

Bus

Shuttle

Sweeper



**230 HP w/ 500 lb-ft**  
**195 HP w/ 420 lb-ft**  
**150 HP w/ 375 ft-lb**  
**195HP w/ 420 ft-lb LPG**

**3,000 + engines running in trucks,  
buses, refuse vehicles**

**50 million miles operational experience  
in North America**





# B5.9G



# B5.9G \* LPG NGV OEM Availability

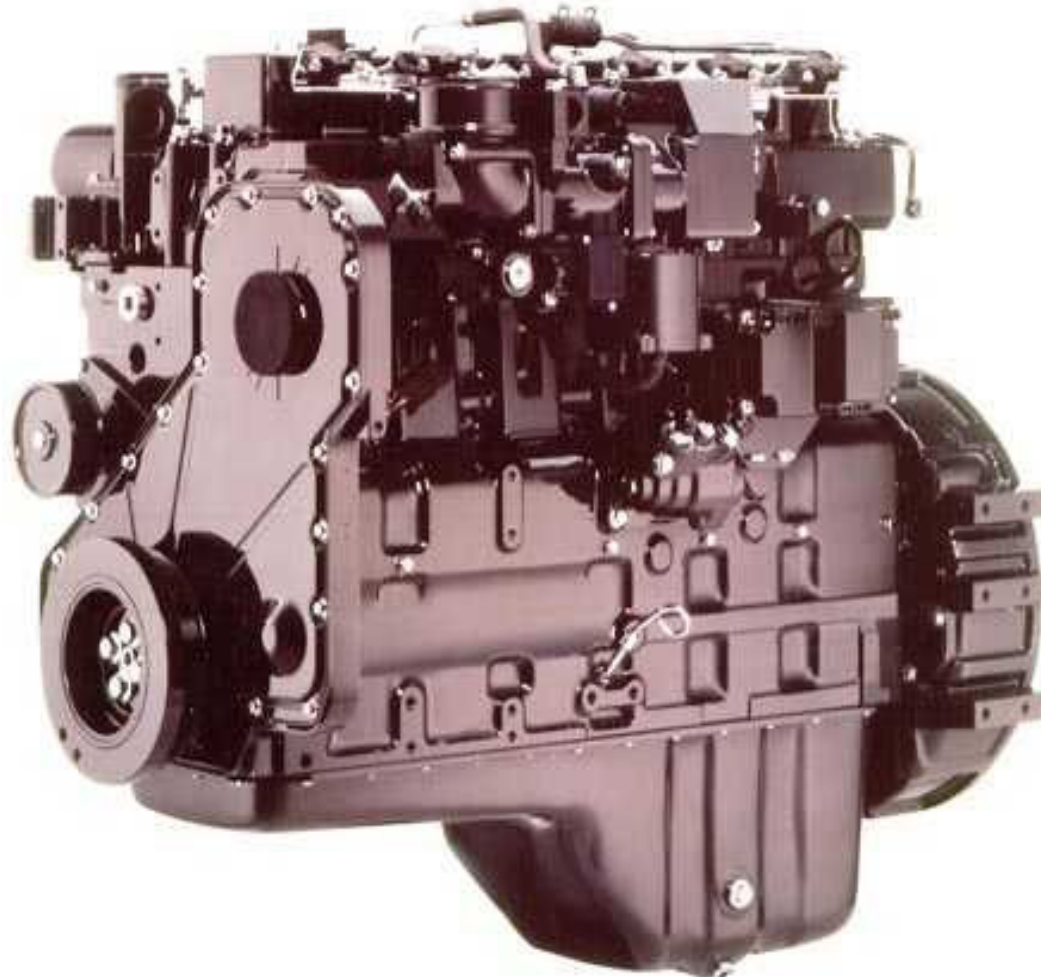
<u>School / Shuttle / Transit</u>	<u>Refuse – Industrial</u>	<u>Medium-Duty Truck - Chassis</u>
Blue Bird	Athey – sweeper	Freightliner – FL50/60/70
Champion Coach*	Crane Carrier	
Chance Coach	Elgin – sweeper	Spartan Motors
Collins	Johnston – sweeper	Freightliner Custom Chassis
El Dorado National	TYMCO – sweeper	
Goshen Coach		
Metrotrans	Hoist Liftruck	
North American Transit	Ottawa	
Neoplan	SISU	
Orion Bus		
Specialty Vehicles		
Thomas Built		
Trolley Enterprises		
<u>Europe</u>		
Dennis Specialty	ERF	ERF
MASA		Leyland - DAF
Optare		Thomas
Van Hool		



## Some North American B5.9G Users

<u>Contact</u>	<u>Company</u>	<u>Phone</u>
William Maurer	Colonial Williamsburg	804/220-7381
Keith Godwin	Greenville Transit Authority	864/467-5000
Dallas Johnson	Univ. of California - Riverside	909/787-4443
Jerry Rickett	Sacramento Int'l Airport	916/874-0745
Jeff Webster	Fresno County Rural Transit	209/233-6789
Jon Johnson	San Benito County	408/637-7665
Don Ridsdill	Laidlaw	416/336-1800

# Cummins C8.3G Plus



Spark ignited  
dedicated natural gas

Refuse

Truck

Transit



# C8.3G Plus Ratings

<u>Model</u>	<u>Horsepower</u>	<u>Peak Torque</u>
<b>C8.3-280G+</b>	<b>280 @ 2400</b>	<b>850 @ 1400 (971)*</b>
<b>C8.3-275G+</b>	<b>275 @ 2400</b>	<b>750 @ 1400 (857)*</b>
<b>C8.3-250G+</b>	<b>250 @ 2400</b>	<b>660 @ 1400 (754)*</b>

\* - Note, when vehicle is geared properly at 2400 RPM with same road speed as a 2100 RPM engine, the effective torque is increased as noted



# C8.3G Plus



## C8.3G Plus - Benefits

- State-of-the-art spark ignition/control system
  - Lean burn, for fuel economy & emissions
  - increased speed, memory & diagnostic capabilities
  - Electronic throttle (drive-by-wire) - faster response and easier installation for bus/truck manufacturers - Woodward governor eliminated
  - Capable of operating on lower quality natural gas
    - Methane number as low as 65
- First engine 2004 EPA certified
  - ULEV & Optional Low NOx certified with catalyst



# INSITE Diagnostic Software

**maintenance, diagnostics, adjustments & repair**



Assists mechanics to quickly program engine,  
analyze faults & troubleshoot engines

## Cummins QuickCheck

- PalmPilot handheld device to:
  - Capture vehicle trip summaries
  - Store maintenance information
  - Log vehicle information
  - Displays SAE fault code information
  - View sensor output data



# C8.3G+ NGV OEM Availability/Potential

## School/Shuttle/Transit

NABI

New Flyer

Nova Bus/TMC

Orion Bus

Neoplan

Thomas Built

## Europe

Berkhof (Netherlands)

Dennis Specialty (UK)

Neoplan (Germany)

Cespele (Hungary)

## Refuse

Crane carrier

Volvo

## H.D.Truck

Freightliner

Dennis Eagle (UK)

Seddon Atkinson (UK)

Ponticelli (FR)

ERF (UK)



# 2001 Low Emissions Certified

	<u>PM</u>	NO <sub>x</sub>	<u>NMHC</u>	<u>CO</u>
B5.9G w/ catalyst (ULEV)	0.02	1.8	0.1	2.7
B5.9LPG w/ catalyst (LEV)	0.01	2.3	0.8	1.0
B5.9G w/o catalyst (LEV)	0.08	2.6	0.1	7.2
C8.3G w/o catalyst (LEV)	0.07	2.2	1.1	7.1
C8.3G w/ catalyst (ULEV)	0.02	1.8	0.6	0.9
C8.3G w/ catalyst (HDUB)	0.01	1.8	0.6	0.9
<b>EPA/CARB Standards</b>	<b>0.1</b>	<b>4.0</b>	<b>1.3</b>	<b>15.5</b>

-HPDI-  
High  
Pressure  
Direct  
Injection  
Class 8  
Heavy Duty

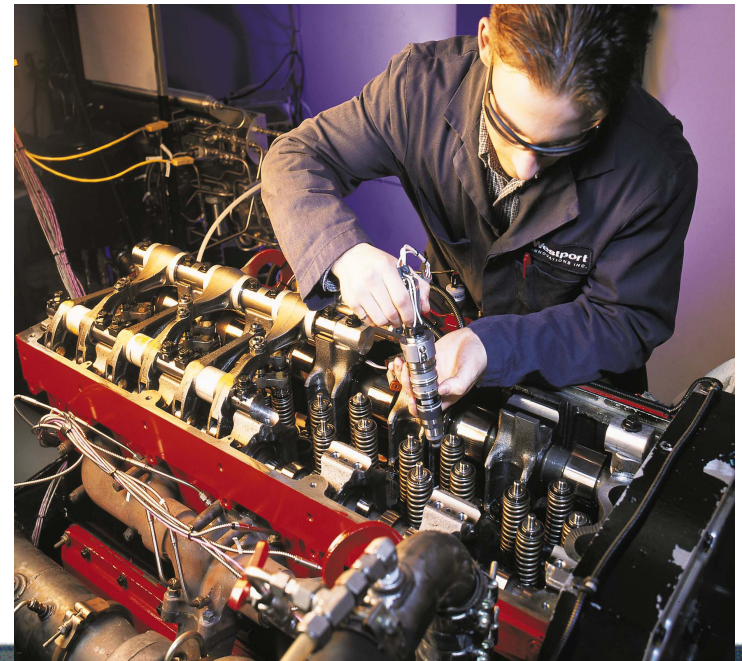




# Westport's Approach

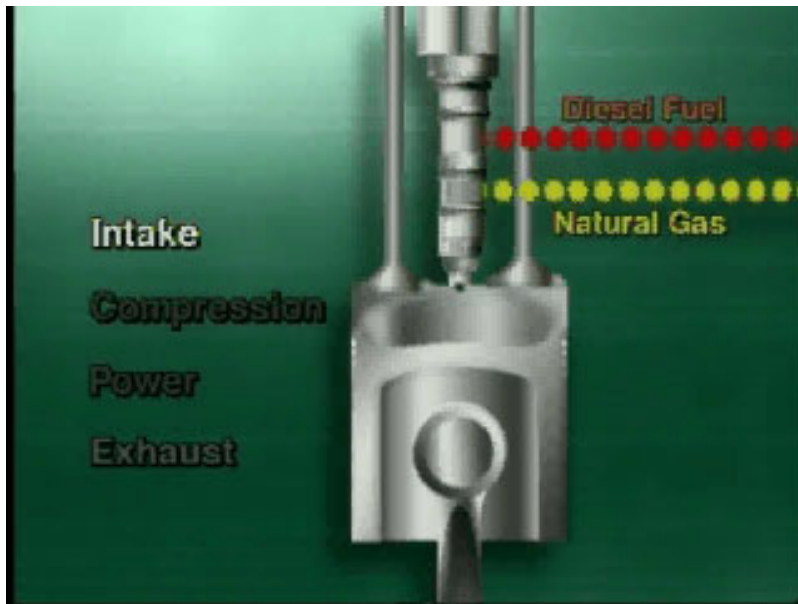
Keep the engine and change the fuel

- Maintains low cost engine production
  - employs same manufacturing process/volume
  - easily adapted for truck builders
- Accepted technology
  - routine engine maintenance
  - fuel system maintained  
by the Cummins distributor



# High Pressure Direct Injection

## -How it Works-



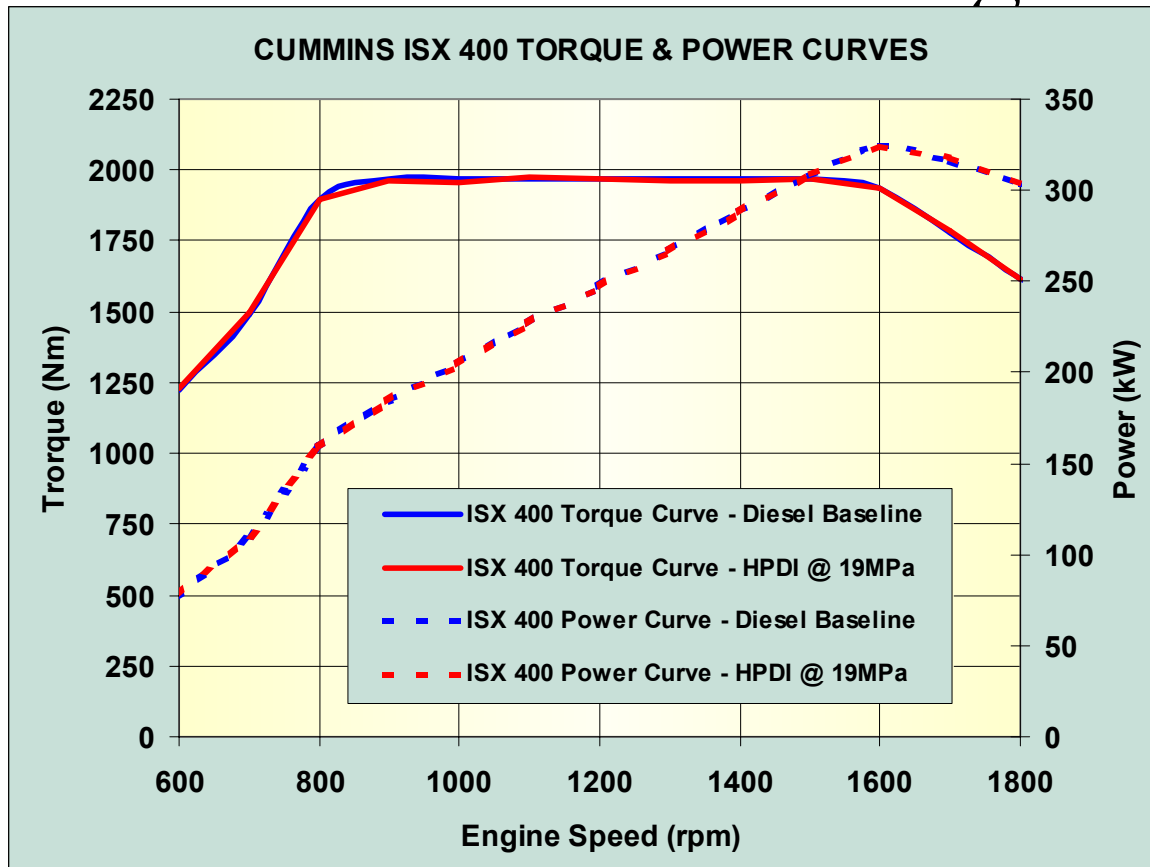
Westport technology reduces both air pollutants and greenhouse gases

*Retains diesel engine torque, power, & fuel economy*

- No premixed air and fuel late-cycle injection of diesel, followed by natural gas
- Not sensitive to fuel composition or knock
- **Averaging 94% Natural Gas**  
High percentage of gas used at all operating conditions including idle

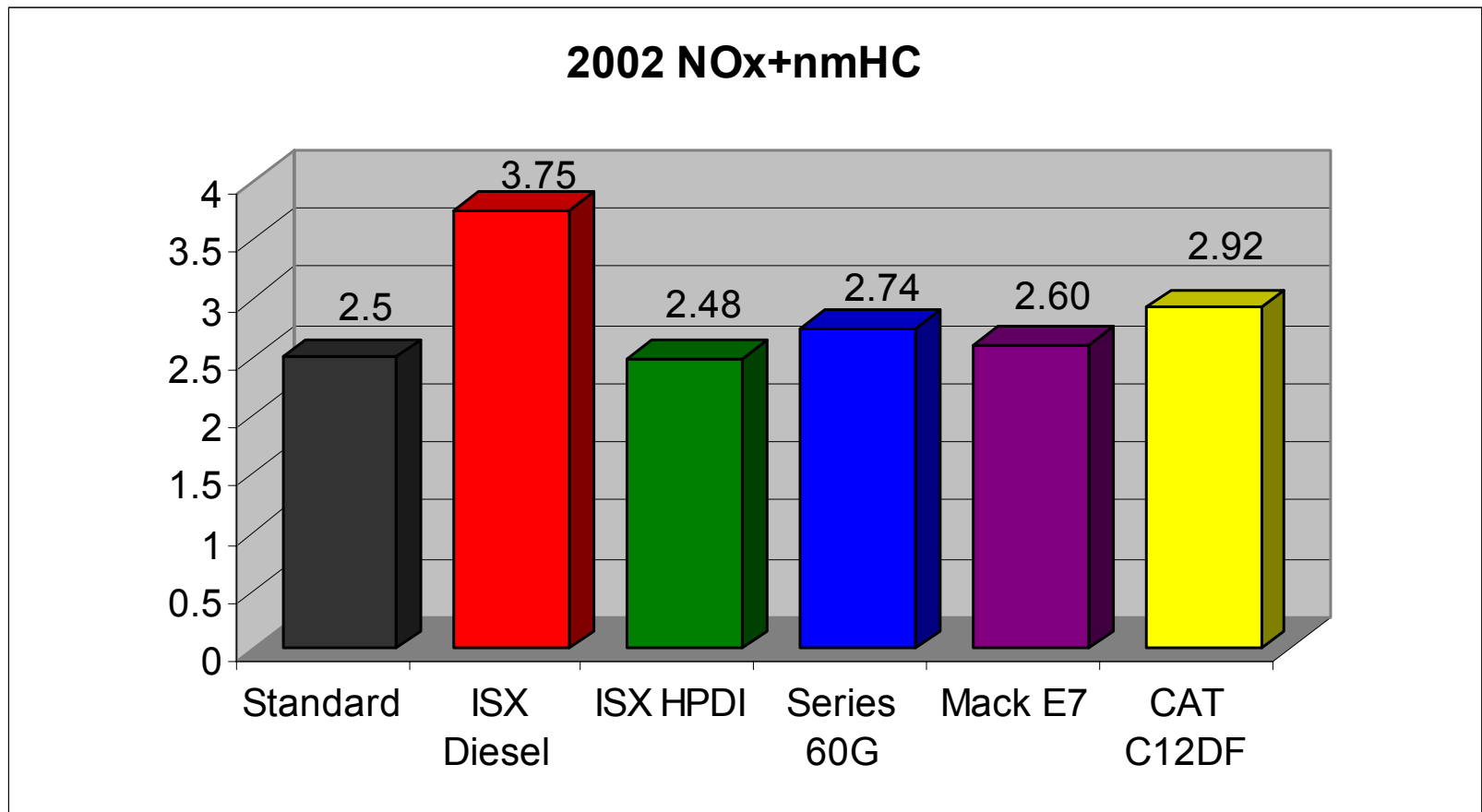


# NG vs Diesel Fuel – Torque of HPDI ISX Truck Engine



Source: Westport

# 2002 NO<sub>x</sub>+nmHC

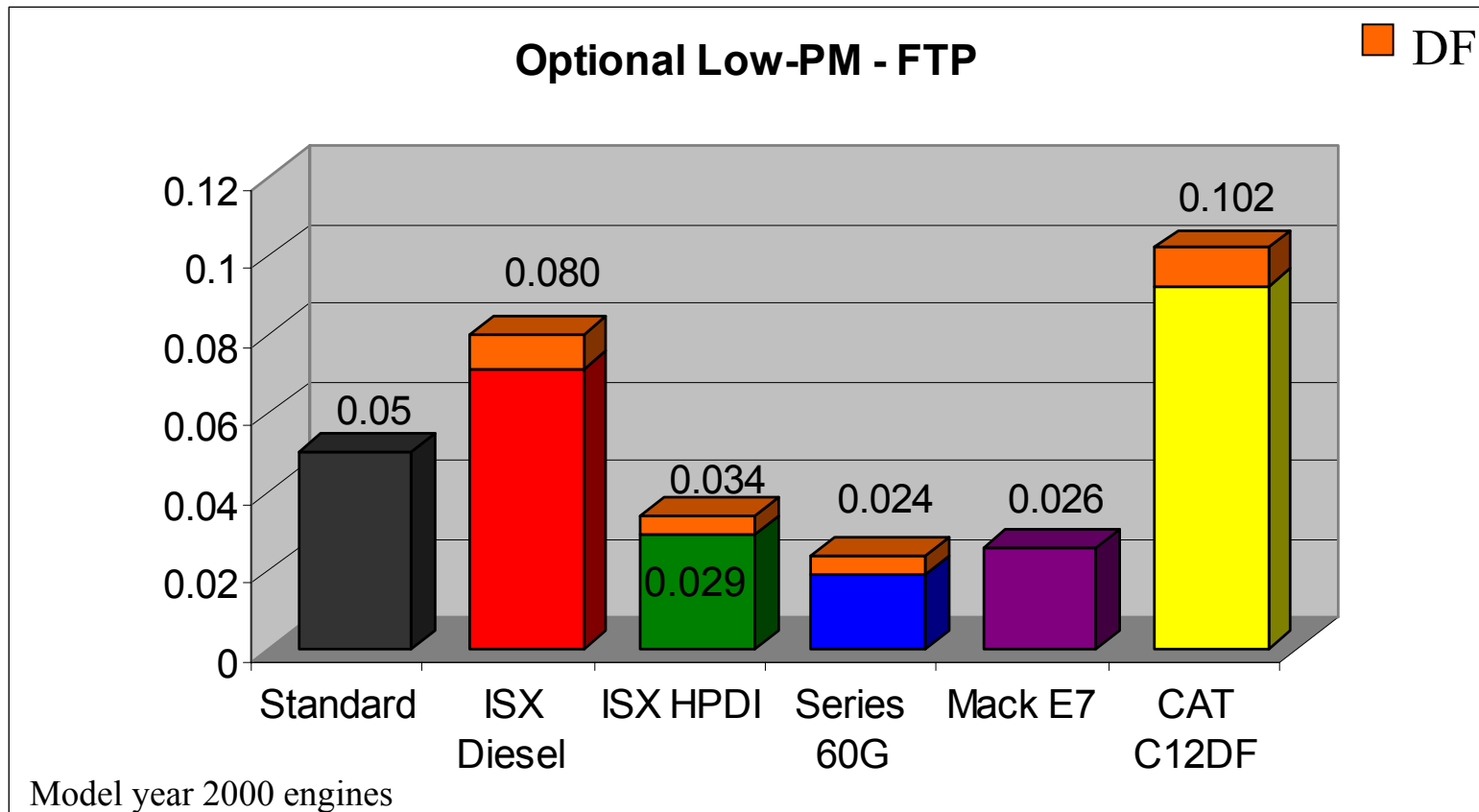


Note: The Series 60 engine exceeds the 0.5 limit on nmHC, and the CAT DF engine is right at the nmHC limit.

Only the ISX HPDI engine meets the stringent 2002 emission levels.

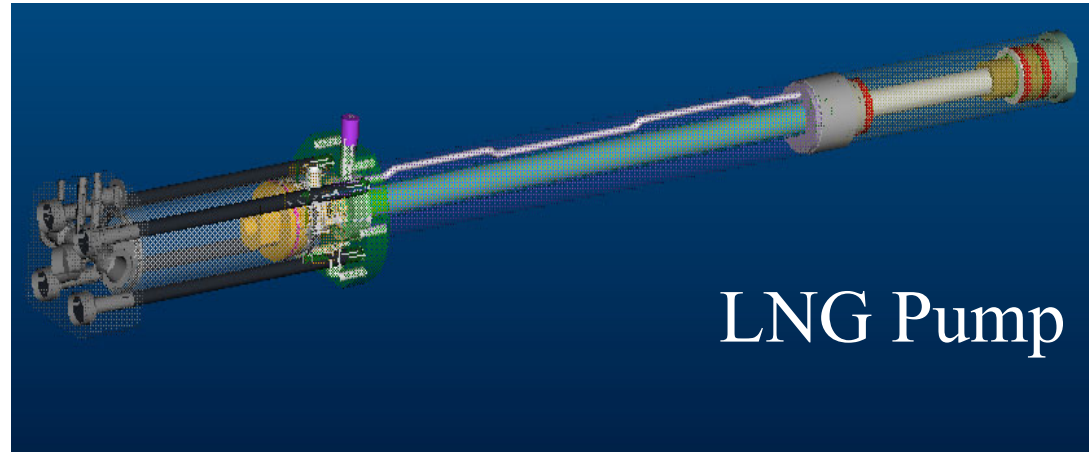
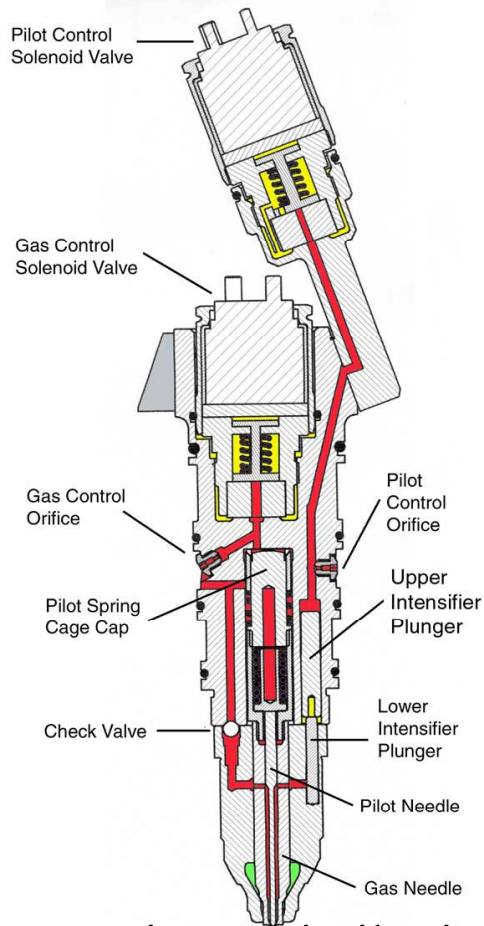


# Particulate Matter



All of the gas engines are well below the optional low-PM standard

# Key HPDI Components



Electronic  
Control Module

- HPDI Injector similar in design to diesel injector



Delivers diesel power and torque with natural gas  
cleanliness and economy

## Raley's Grocery Stores



*New customer*

*Norcal Waste – 14 trucks by late fall 2001*

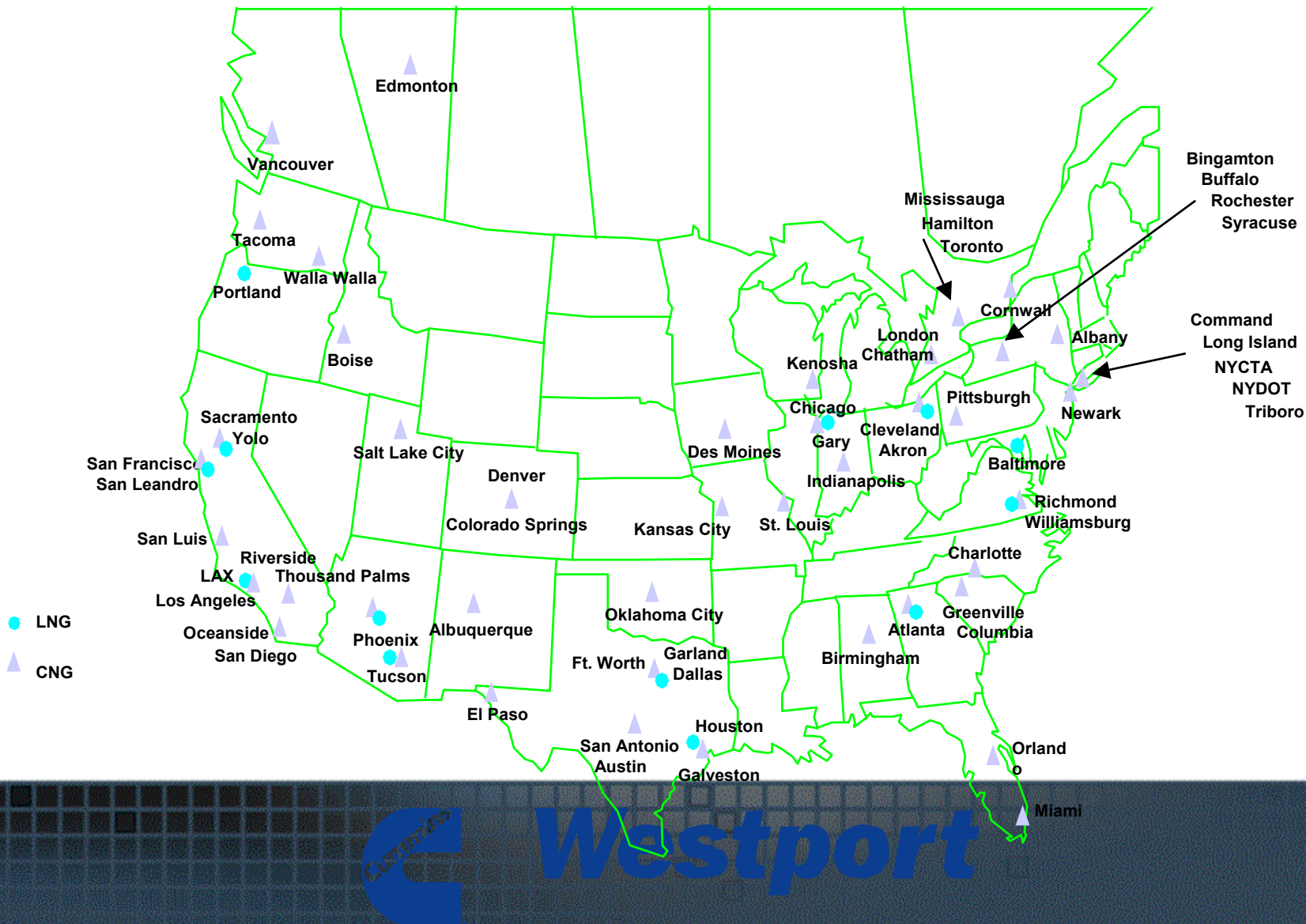
Bobell



Westport



# Cummins NG Locations - US/Canada







# Westport Partners

**Westport**  
INNOVATIONS INC.

## Cummins Westport Inc.



## MAN AG



## FORD



*N-Series*



*F-Series*



# Westport